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UNITED STATES DEPARTMENT OF AGRICULTURE
BULLETIN No. 617
Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. **PROFESSIONAL PAPER** **September 23, 1919**

AUSTRALIAN SALTBUSH.

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EARLY TESTS OF THE AUSTRALIAN SALTBUSH.

The Australian saltbush (*Atriplex semibaccata*) was introduced into the United States some 25 years ago and was distributed more or less generally throughout the arid and semiarid regions. The very high hopes held at that time regarding its prospective value have not been realized. Except in California and Arizona the plantings resulted in failure, and in those States under cultivation it is unable to compete with more productive crops, like alfalfa and beans. In early trials in California it did quite well and was so reported by the State experiment station writers and others. The early plantings in Arizona resulted in failure and only with the development of irrigation has it become well established in that State. For a number of years, and especially between the years 1900 and 1910, Australian saltbush seed was grown by the California experimental substation, located at Tulare, and by Mr. Guy E. Heaton, of Paso Robles, Calif. The seed grown at these places was distributed gratis or sold through commercial channels, and the larger part was probably planted on the arid range lands of the Southwest.

Except in California, plantings made on the range lands were failures, and in general the use of this saltbush for range purposes was not considered a success. However, some of the plantings along the coastal region about Los Angeles and San Diego seem to have done exceptionally well, and from these plantings it promptly escaped, spreading over range lands and waste places throughout the coastal area and islands from the Mexican border on the south to the Salinas Valley on the north. There it constitutes a real asset, providing pasturage at a season when most other forage plants are dormant. While the actual outcome of the introduction of Australian saltbush is very different from early high hopes and predictions, the facts justify the conclusion that its introduction has proved a benefit to those areas where it has become naturalized.

DESCRIPTION OF THE PLANT.[1]

The Australian saltbush is a semiwoody, prostrate perennial, forming a dense mass 6 to 12 inches thick. (Fig. 1.) The leaves are linear, 1 inch long, and coarsely toothed along the margins. The seed is small and inclosed in a pair of fleshy foliaceous bracts which become red as the fruit matures. The plants are perhaps long-lived

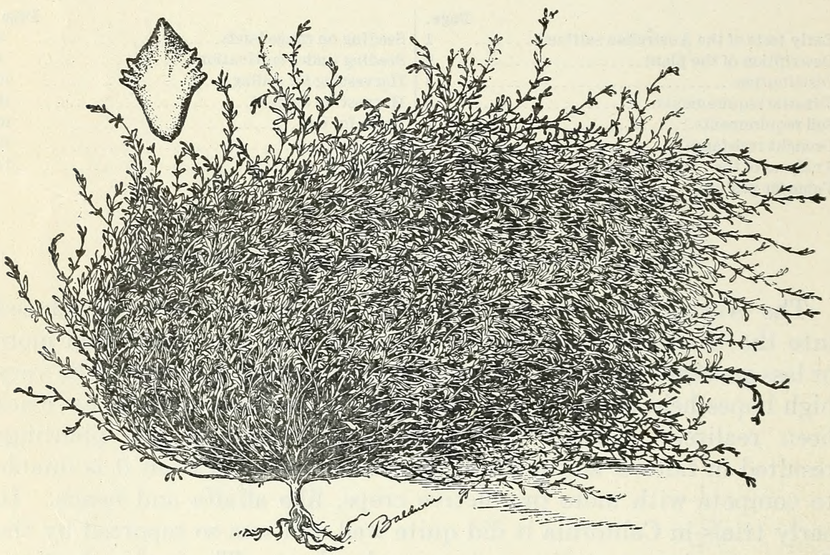

FIG. 1.—A plant of Australian saltbush (*Atriplex semibaccata*) grown in a grass garden.

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[1] In newspapers and popular magazines, the Rosy saltbush (*Atriplex rosea*) has been confused with the Australian saltbush (*Atriplex semibaccata*). Rosy saltbush is an annual, native to Europe, and much resembles in appearance and habits the common tumbleweed. In the last 15 years it has spread with great rapidity over nearly all of the semiarid States. It prefers alkaline soil, but spreads as a weed on all farm lands, much as does the Russian thistle. In the East it is a rather rare weed in waste places and appeared in New York and New Jersey as early as 1879. In the West it was found in Wyoming in 1897 and in Oregon and Washington in 1901. Since then it has spread over most of the area west of the one hundredth meridian and in many places is found in such great abundance as to be a troublesome weed. While this plant is usually considered as a weed only, it has some merit, as have most weeds. Sheep and other stock will browse it when other and better feed is not available, but it is no better than tumbleweed or Russian thistle in this respect. While it has some value as forage, it probably does not possess sufficient merit to justify any one in purposely planting it on his farm.

perennials, but under some conditions they live but two or three years. Near Paso Robles, Calif., where they have been grown under cultivation, the growth is strong and vigorous the first year, becomes much weakened in the second year, and after that the plants soon succumb. (Fig. 2.) In this particular locality this saltbush has not become aggressive, and while a few plants have escaped from cultivation, they are weak and spindling and do not show the usual vigor of plants under cultivation the first year. While there are no definite records as to the length of life of these plants in favorable regions, such as Los Angeles and San Diego, from general appearances it would seem that they live for a number of years.

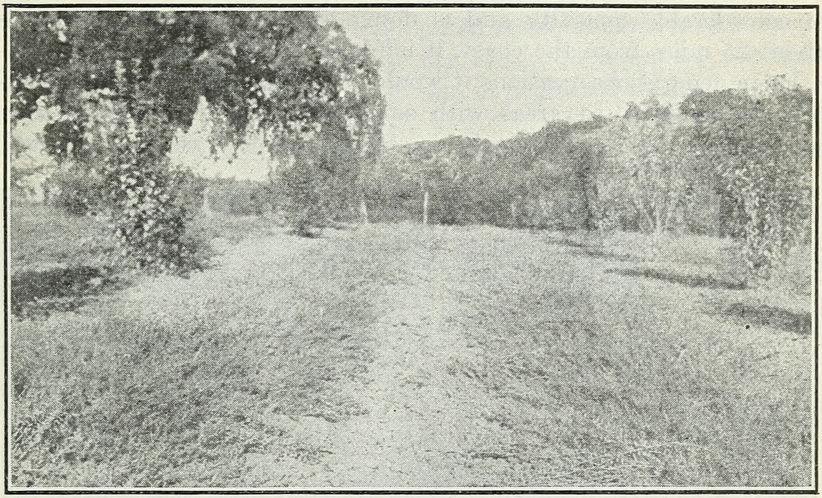

FIG. 2.—The Australian saltbush grown under cultivation in a young apple orchard at Paso Robles, Calif.

DISTRIBUTION.

The Australian saltbush has become naturalized, that is, fully established, only in California and Arizona. In California it is confined to the coastal region south of San Francisco and to the irrigated districts of the Imperial Valley and the upper San Joaquin Valley, centering about Tulare and Bakersfield. In Arizona it is found in the agricultural areas of the Salt River Valley about Phoenix, in the Santa Cruz Valley about Tucson, and in the Yuma Valley near Yuma. The northern limit where this saltbush has been observed is Hollister, Calif., about 100 miles south of San Francisco. In this district it occurs in small quantity, and while it makes a very luxuriant growth it does not develop seed in such abundance as farther south. In the Salinas Valley, Calif., it is found all the way from Salinas to some distance beyond Soledad. It is not abundant in this valley, but the plants make a vigorous growth and develop a heavy crop of seed. It is probable that this saltbush has been but recently introduced into the Salinas Valley, which may account for its lack of abundance at present.

The climatic and other conditions in the coastal region in California seem to be especially favorable to the Australian saltbush, and it is found almost everywhere from Santa Barbara to San Diego. (Fig. 3.) It generally extends inland a distance of 10 to 15 miles, but is found in small quantities at much greater distances. At Highlands, which is about 45 miles from the coast and due east of Los Angeles, it occurs in considerable quantity and is doing well. At Corona, which is about 25 miles from the coast, it is found in abundance.

From general observations it would seem that the Australian saltbush is confined to areas with somewhat favorable soil-moisture conditions. On the extremely dry areas, on the lower levels as well as at higher elevations, it is not found. Along the immediate coast in the fog belt it does extremely well, which apparently is due to the fact that the fog supplies the moisture essential to its growth. While the present distribution of this saltbush is confined almost exclusively to the lower altitudes, it occurs in small quantity at an altitude of 1,800 feet near Alpine, Calif., and at 1,400 feet near Ramona, Calif. It is probable that temperature and moisture conditions rather than altitude determine the limits of growth of this plant; however, observations on this point are very limited.

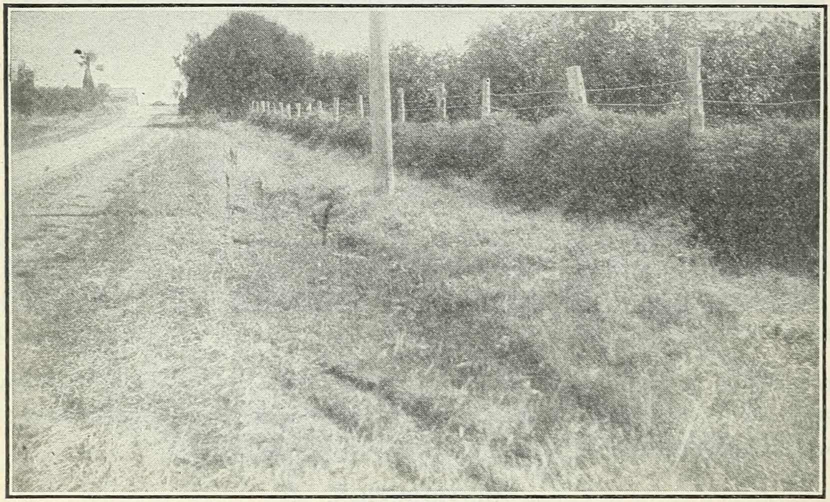

FIG. 3.—The Australian saltbush growing along a roadside fence near San Diego, Calif.

In the upper San Joaquin Valley the Australian saltbush occurs in abundance, but its distribution in this region is confined to irrigated or semi-irrigated lands. For some miles west of Bakersfield and extending northwest of Wasco and east to Famosa it is found in practically all cultivated fields and along roadsides, and it grows luxuriantly in irrigated alfalfa fields both on the levees or ridges and in the borders or checks throughout the fields. About Tulare it does not do so well as in the Bakersfield-Wasco area. However, it appears in considerable quantity on the higher ground along fences and on well-raised ridges in irrigated fields. The lands about Tulare are low, poorly drained, and quite wet during the winter. Apparently this wet condition is the factor that limited the spread of this saltbush in this area.

In Arizona the Australian saltbush is largely confined to the irrigated areas, where it is found growing along ditch banks, roadsides, and in neglected fields.

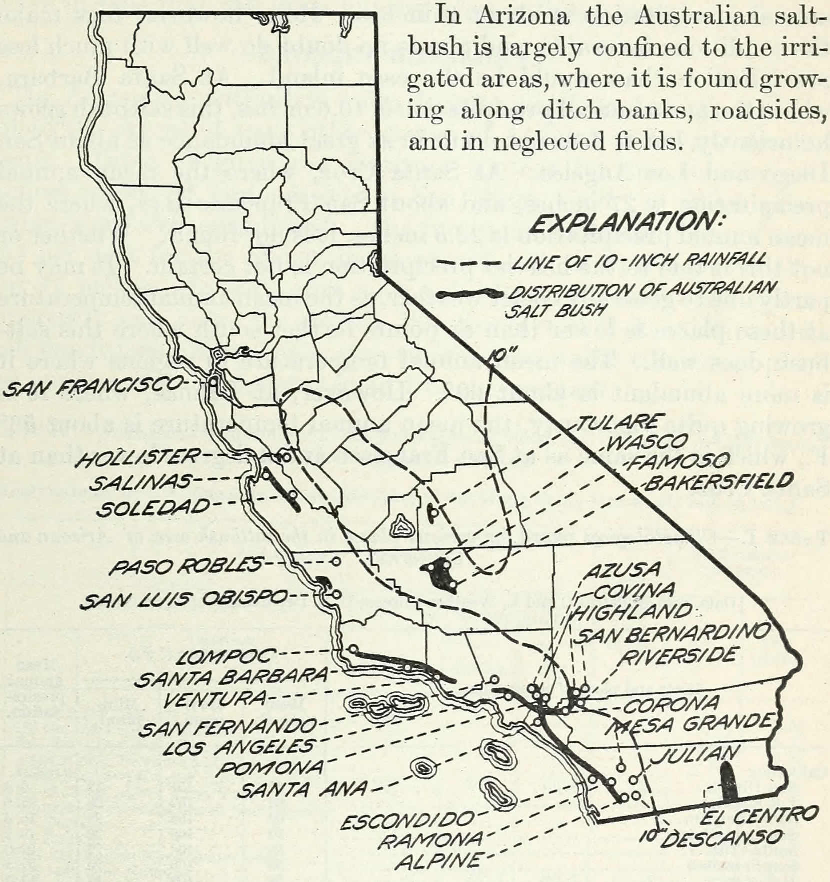

FIG. 4.—Outline map of California, showing the distribution of the Australian saltbush.

The accompanying map shows the present distribution of the Australian saltbush in California, as far as known. (Fig. 4.)

CLIMATIC REQUIREMENTS.

The climatological record of various places in the Australian saltbush area of California and Arizona is given in Table I. The maximum temperature recorded is 118° F., at Yuma, Ariz. At Bakersfield, Calif., and at Phoenix and Tucson, Ariz., where high temperatures are recorded, this saltbush grows luxuriantly. Along the coast, where high temperatures are seldom recorded, it does equally well. The minimum temperature recorded at any place in California or Arizona where it is known to be growing at the present time is 10° F., at Tucson, Ariz.

The mean annual precipitation at places in California where the Australian saltbush is growing well without irrigation ranges from 9 to 19 inches. This saltbush thrives about San Diego, where the mean annual precipitation is about 9 inches. Here, however, fogs make the conditions favorable, and plants no doubt do well with much less precipitation than would be the case inland. At Santa Barbara, where the mean annual precipitation is 16.6 inches, this saltbush grows luxuriantly, but it does not occur in as great abundance as about San Diego and Los Angeles. At Santa Cruz, where the mean annual precipitation is 27 inches, and about San Francisco Bay, where the mean annual precipitation is 22.5 inches, it is not found. Whether or not this is due to the heavier precipitation is not certain. It may be partly due to generally cooler weather, as the mean annual temperature at these places is lower than at points farther south where this saltbush does well. The mean annual temperature in regions where it is more abundant is about 60°. However, at Salinas, where it is growing quite vigorously, the mean annual temperature is about 56° F., which is the same as at San Francisco and 2 degrees lower than at Santa Cruz.

TABLE I.—*Climatological record for various places in the saltbush area of Arizona and California.*

[Data from Bulletins Q and L, Weather Bureau, U. S. Department of Agriculture.]

State and place of observation.	Temperature (° F.).			Mean annual precipitation.
	Mean annual.	Maximum.	Minimum.	
California:				*Inches.*
San Diego	61	101	32	9.4
Los Angeles	62	109	28	15.6
Santa Barbara	60	100	28	16.6
San Luis Obispo	59	106	22	19.2
Santa Cruz	58	108	22	27.0
San Francisco	56	100	29	22.5
Hollister	59	105	19	12.3
San Jose	58	104	18	14.8
Salinas	56	95	20	14.12
Soledad				8.97
Kings City	58	114	15	10.8
Redlands	64	113	25	14.7
Riverside	62.9			10.01
Fresno	63	114	20	9.2
Tulare				7.65
Bakersfield	66	114	19	4.8
Mojave	65.5	114	15	4.79
Arizona:				
Yuma	72.0	118	22	2.7
Phoenix	70.0	116	22	6.8
Tucson	68.0	112	10	9.8

SOIL REQUIREMENTS.

While the Australian saltbush has been noted as growing on practically all types of soil, it occurs in but few regions where the soil does not contain a greater or less amount of alkali. Table II presents the analysis of various soils in which it was found growing. It is to be noted that the salt content ranges from nothing to 2.61 per cent of the dry weight. This saltbush is quite tolerant of alkali, and will thrive in soils that will grow but very few ordinary crops.

DROUGHT RESISTANCE.

The Australian saltbush is quite drought resistant, but apparently not to the extent of some other species of Atriplex and many desert plants. Table II gives the moisture content for the summer or rainless season of various soils at San Diego, Calif., in which saltbushes were well established. The minimum moisture content was 1.51 per cent for the first 6 inches of soil and 1.75 per cent for the first 12 inches. In soils with such low moisture content the plant apparently can make no growth, but the fact that it exists under such conditions and resumes growth when favorable conditions prevail entitles it to be designated as drought resistant.

TABLE II.—*Sodium-chlorid content of the Australian saltbush and of the soil in California in which it was found growing.*

[Analyses made by J. F. Breazeale; soil samples taken at San Diego, Calif., Aug. 23 and Sept. 4, 1918.]

Soil sample.				Soil moisture (per cent).	NaCl content (per cent).	
No.	Location.	Weight (gramr).			Soil.	Dry plant.
		Initial.	Dry.			
1	90 feet from high tide				0.104	7.01
2	120 feet from edge of salt flat				.035	8.17
3	Salt flat, at edge of seepage				.435	8.17
4	Edge of bay, moistened at high tide				1.710	16.34
5	Mesa, near Sweetwater dam (first 6 inches of soil)	269.0	265.0	1.51	.030	8.40
6	Levee, 3 feet above water level				.047	13.05
	Depression by levee, moist and alkaline:					
7	Topsoil				1.110	15.66
8	Subsoil				1.110	
9	Salt flat, a little above water level				2.610	23.20
10	Dry soil, near Ramona	267.1	262.5	1.75	.020	4.64
	Dry gravelly ridge, at Chula Vista:					
11	First foot	250.7	237.3	5.65	0	8.70
12	Second foot	297.1	272.1	9.19		
13	Third foot (8 inches)	191.5	176.0	8.80		
	Dry level spot not cultivated for 3 years:					
14	First foot	250.6	239.5	4.63		
15	Second foot	312.3	293.0	6.58		
16	Third foot	356.8	330.0	8.12		
	Paso Robles				.06	.87

In the extremely dry areas where the annual precipitation is low and the surface soils usually dry, as in the Bakersfield and Mojave regions, the Australian saltbush does not occur. However, in these regions a number of other desert plants, including other species of Atriplex, are found in abundance. The absence of this saltbush in these regions is perhaps due in part to the fact that considerable humidity and surface soil moisture are essential for the germination of the seed and growth of the young plant, and such conditions seldom exist at any period of the year in the regions mentioned.

ANALYSES OF THE PLANT.

In Tables II and III are given analyses of the tops or stems and leaves of Australian saltbush plants. In Table II only the sodium-chlorid content is shown. An attempt has been made to correlate the sodium-chlorid content of the plant with the sodium-chlorid content of the soil in which it was growing. It will be noted that the plants containing the greatest percentage of sodium chlorid were grown in the soil having the greatest percentage of this substance. This relation, however, does not always hold true, for some of the soils with low sodium-chlorid content produce plants high in this substance; but in general there seems to be a positive correlation between soils with high sodium-chlorid content and plants high in this compound.

The analyses given in Table III show that saltbush forage has a comparatively high content of protein and of nitrogen-free extract and crude fat. These data, however, are not indicative of its feeding value, as the high sodium-chlorid content has to be taken into consideration.

TABLE III.—*Composition of the Australian saltbush compared with that of alfalfa.*

[From Farmers' Bulletin 108, p. 15.]

Material.	Constituents (per cent).					
	Moisture.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Crude fat.
Green stems and leaves:						
Australian saltbush	78.03	4.58	2.75	3.75	10.41	0.48
Alfalfa	75.04	1.80	4.91	6.34	11.09	.86
Hay samples:						
Australian saltbush	7.05	19.37	11.64	15.88	44.05	2.01
Alfalfa	10.95	6.43	17.60	22.63	39.31	3.08

VALUE FOR PASTURE.

In regions to which it is adapted the Australian saltbush is quite aggressive and this characteristic makes it more valuable for pasture purposes. It grows readily from seed and is distributed by the seed being carried in various ways from place to place. The introduction of this saltbush into new localities has followed the traveled highways, railroads, and overland trails.

On account of its high salt content the Australian saltbush is not as palatable as most ordinary forage, but it is eaten readily by sheep, goats, cattle, and horses when other forage is scarce. By reason of its nonpalatability it is avoided early in the season when other forage is plentiful, and thus is available in a green state later in the summer when most other plants have become entirely dry. Its ability to furnish succulent feed which serves as a reserve supply in late summer seems to constitute the real value of this plant. It is not sufficiently drought resistant to grow in areas where other and better forage plants will not succeed, and for this reason its use must be confined to the more favorable regions where it will serve as a reserve supply in late summer, as already indicated.

To be of the greatest value the Australian saltbush must be supplemented with other feeds. If fed alone stock will eat it only in limited quantities on account of its high salt content, and for the same reason when eaten in large quantity it is more or less injurious to animals.

SEEDING ON RANGE LANDS.

There is but little information regarding the best practice in seeding the Australian saltbush on pasture and range lands. However, in view of the fact that under natural conditions the seed ripens in the fall and drops to the ground soon afterward, it would seem that fall seeding may well be practiced. It is possible that spring seeding may give good results under conditions where weeds or competing plants are not abundant, but where winter-growing annuals have already made a good growth and summer annuals are beginning growth it is not likely that this saltbush will have much chance to establish itself.

The only thing that can be done economically is to scatter the seed broadcast in favorable locations and allow it to take care of itself. If it will not grow and reseed itself under such conditions it can not be used profitably for range purposes.

SEEDING UNDER CULTIVATION.

In growing the Australian saltbush under cultivation the best time for seeding is in the spring, about the time that corn ordinarily would be planted. The land should be well prepared, as for any other small-seeded crop, by plowing and subsequent harrowings. Care should be taken to cover the seed very shallow. Seed planted deep will not germinate, and for this reason it is necessary to have good moisture conditions at the surface, so that shallow-planted seed will receive enough moisture to insure germination. The planting should be made in rows about 3½ feet apart, and cultivation should be given as for any ordinary field crop planted in rows.

HARVESTING FOR SOILING.

The Australian saltbush makes a fair soiling crop, and for this purpose it can be cut at any time after the plants have made sufficient growth to warrant handling. The plants remain green and hold their leaves late in the season, and consequently it can be used in the fall as well as early. The saltbush handled in this way is eaten quite readily by stock, but for the best results it should be fed with other forage and, if possible, supplemented with grain feed.

On account of the plants being very prostrate they can not be cut with an ordinary mowing machine unless some device is attached for lifting the stems. However, it is probable that one would want to feed saltbush in this way only in very limited quantities or for very short periods, and under such conditions it could be cut with an ordinary scythe.

HARVESTING FOR SEED.

The seed of the Australian saltbush drops from the plant very readily as soon as it is ripe, and for this reason it can not be cut and handled for seed like most other crops. The best method of procedure in harvesting the seed is to place a piece of canvas about 6 by 3 feet in dimensions under the plants and then knock the seed off with a stick or flail. This method is somewhat slow, but there seems to be no easier way of harvesting this seed. After the seed has been knocked from the plants it should be spread on a large canvas to dry. On account of the moisture contained in the pulpy bracts inclosing the seed it can not be put immediately in sacks or in large piles without heating. After it has been dried it can be sacked and stored like any other seed. The seed of this saltbush ripens in the latter part of August and through September. It does not ripen all at once, so that one must determine when a maximum of seed is ready to harvest. Under favorable conditions about 300 pounds of seed can be secured from an acre.

VALUE FOR HAY.

The Australian saltbush possesses but little value for hay. The stems are too woody for this purpose, and on account of the plants being very prostrate the handling at best would be quite expensive.

DISEASES.

A diseased condition of plants of *Atriplex semibaccata* was noted as occurring quite commonly in the Los Angeles and San Diego region. These diseased plants presented a blackened or sooty appearance, with the tops or upper stems and leaves most severely affected. Specimens collected at Chula Vista, Calif., on September 4, 1918, were presented to Miss Vera K. Charles, who has identified the organisms causing this condition as *Macrosporium commune* Rabh. and *Cladosporium herbarum* (Pers.) Link. These, she states, are not known to occur except as saprophytes. As the plants on which these fungi were found are not in a dead or abnormal condition except in the parts where these fungi occur, it seems probable that insect injury, sun scald, or some other destructive agency preceded the fungi.

SUMMARY.

The Australian saltbush was introduced throughout the semiarid regions of the United States some 25 years ago. In practically all cases the plantings resulted in failure, and only along the coast and in the San Joaquin and Imperial Valleys of California and in the Salt River, Yuma, and Santa Cruz Valleys of Arizona has it become well established.

The plant is perennial and prostrate, forming a dense mass from 6 to 12 inches thick.

The minimum temperature of any region in which it is naturalized is 19° F. The mean annual precipitation of regions in which it is growing successfully without irrigation ranges from 9 to 16 inches.

While the Australian saltbush has been noted as growing on practically all types of soil, it is found in but few regions where the soil does not contain an appreciable amount of alkali.

It is quite drought resistant, but apparently not to the extent of some other species of Atriplex and other desert plants.

Chemical analyses of the leaves and stems of the Australian saltbush show that they have an unusually high content of common salt and comparatively large percentages of protein, nitrogen-free extract, and crude fat.

In regions to which it is adapted the Australian saltbush is quite aggressive, and this characteristic adds to its value as a range plant.

On account of its high salt content, it is not as palatable as most ordinary forages, but it is eaten readily by sheep, goats, cattle, and horses when other feed is scarce. To be of greatest value it must be supplemented with other feeds.

The greatest value of the plant is to supply succulent feed in late summer and to furnish a reserve supply. It can be used as a soiling crop, but has little value as hay.

Seed is produced freely, but harvesting is expensive. For range purposes Australian saltbush seed should be sown in the fall. The only thing that can be done economically is to scatter the seed broadcast in favorable locations and allow it to take care of itself.

In seeding for growing under cultivation, care should be taken to cover the seed only enough to insure moisture conditions favorable for germination.

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WASHINGTON : GOVERNMENT PRINTING OFFICE : 1919